No of Pages : 3 Course Code : 12P305

Roll No:
(To be filled in by the candidate)

PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

SEMESTER EXAMINATIONS, AUGUST / SEPTEMBER - 2014

BE / BE(SW) - PRODUCTION ENGINEERING Semester: 3 / 4

12P305 FLUID MECHANICS AND MACHINERY

Time : 3 Hours **Maximum Marks : 100**

INSTRUCTIONS:

1. Group I, Group II and Group III questions should be answered in the Main Answer Book.
2. Ignore the box titled as **"Answers for Group III"** in the Main Answer Book.
3. Answer **ALL** questions from GROUP – I.
4. Answer any **FOUR questions** from GROUP – II.
5. Answer any **ONE** question from GROUP – III.
6. **Moody's Chart, Fluid properties and Minor loss coefficient tables** may be permitted.
7. **Graph Sheet** is to be provided.
8. **State the assumptions wherever necessary while answering Group II and III**

GROUP - I **Marks : 10 x 3 = 30**

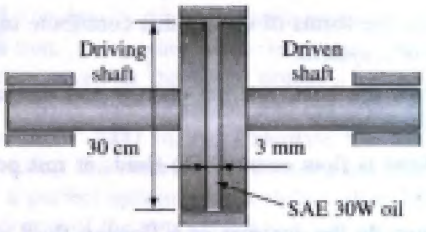
1. Define streamline and path line.
2. Define the stream function ψ through expressions using u(x,y) and v(x,y) and show that ψ satisfies the Laplace equation $\nabla^2 \psi = 0$ when the flow is irrotational.
3. Write the meaning of no slip condition.
4. Choose whether the following statements are true or false and justify the answer.
   A. boundary layer thickness increases with increase in Reynolds number at a point.
   B. boundary layer thickness increases with increase in fluid density.
5. A piping system involves two pipes of different diameter (but of identical length, material, roughness) connected in series. Compare the flow rates and pressure drops in these two pipes. Ignore minor losses.
6. What is hydrodynamic entry length in pipes?
7. Write the significance of blockage ratio in wind tunnel experiments.
8. If velocity distribution in laminar boundary layer over a flat plate is assumed to be a second order polynomial $u = a+by+cy^2$, determine the constants using necessary boundary conditions.
9. Choose whether the following statements are true or false and justify the answer. "At the pump's free delivery efficiency of the pump is zero".
10. Define specific speed of a fluid machine.

GROUP - II **Marks : 4 x 12.5 = 50**

11. a. Show that the shear stress on a plane is proportional to the velocity gradient perpendicular to the plane. (6.5)

b. A 1.9 mm diameter tube is inserted into an unknown liquid whose density is 960 kg/m^3 and it is observed that the liquid rises 5 mm in the tube, making a contact angle of 15°. Determine the surface tension of the liquid. (6)

12. The clutch system shown in fig is used to transmit torque through a 3 mm thick oil film with μ= 0.38 Ns / m^2 between two identical 30 cm diameter discs. When the driving shaft rotates at a speed of 1450 rpm, the driven shaft is observed to rotate at 1398 rpm. Assuming a linear velocity profile for the oil film, determine the transmitted torque.



13. Air is flowing over a smooth flat plate with a velocity of 12 m / s. The length of the plate is 1.1 m and width 0.9 m. If laminar boundary layer exists up to a value of 2 x 10^5 , and kinematic viscosity of air is 0.15 stokes, find a. the maximum distance from the leading edge up to which laminar boundary layer exists; b. maximum thickness of boundary layer.

14. A Francis turbine with an overall efficiency of 75% is required to produce 150 kW at the shaft. It is working under a head of 7.62 m. The wheel runs at 150 rpm and the hydraulic losses in the turbine are 22% of the available energy. Assuming radial discharge, determine (a) guide blade angle (b) vane angle at inlet (c) diameter of the wheel at the inlet (d) width of the wheel at the inlet. Take peripheral velocity = $0.26(2gH)^{1/2}$ and $V_{f1} = 0.96(2gH)^{1/2}$.

15. A hydraulic press is powered by a remote high pressure pump. The gauge pressure at the pump outlet is 20 Mpa, whereas the pressure reduces to 19 Mpa at the press at a flow rate of 0.032 m^3 / min. The press and the pump are at the same elevation and are connected by 50 m of steel tubing. The fluid is SAE 10W oil (viscosity 3.3 E-2 N s / m^2; S = 0.92). Determine the minimum tubing diameter that may be used. Assume the flow to be laminar and neglect minor losses.

GROUP - III Marks : 1 x 20 = 20

16. A Pelton wheel nozzle with C_v = 0.97, is 400m below the water surface of a lake. The jet diameter is 80 mm, the pipe diameter is 0.6 m with a total length of 4 km and friction factor = 0.032. The buckets deflect the jets through 165° and they run at 0.48 times the jet speed. The relative velocity at outlet is reduced by 15% of the relative velocity at the inlet due to bucket friction. Assuming 90% mechanical efficiency, find the flow rate and shaft power developed by the turbine.

17. Water at 10° C flows through a pipe of diameter 1.85 cm into a glass of volume 0.355 litres. Determine - a) the minimum time taken to completely fill the glass if the flow is to be laminar (Re = 2100) b) the maximum time taken to completely fill the glass if the flow is to be turbulent (Re = 4000) c) repeat the calculations (for both the flows) for every 10° C rise in temperature upto 60° C and plot the temperature vs time results. Comment on the variation of time to fill the glass due to the rise in temperature for the given conditions.

/END/

FD/RL